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ABSTRACT

The main objective of this study was to show whether eighth graders' performance on standardized mathematics tests could be predicted from a variety of variables. These predictors included gender, race, socioeconomic status, and previously earned grades in mathematics. Data came from the base year of the National Educational Longitudinal Study of Eight Graders (NELS 88). A random sample of 180 students consisting of 30 Black males, 30 Black females, 30 White males, 30 White females, 30 Hispanic males, and 30 Hispanic females were selected from the data set. Multiple regression analysis was used to analyze the data. Females were no less likely to score well on mathematics standardized tests than were their male counterparts. However, there were differences between racial groups. The effects of socioeconomic status varied among groups but were found to be consistently significant across racial lines. (Contains 26 references.) (Author/ASK)

An Investigation of the Effects of Gender, Socioeconomic Status, Race and Grades on Standardized Test Scores

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Abstract

The main objective of this study was to show whether eighth graders' performance on standardized mathematics tests could be predicted from a variety of variables. These predictors included gender, race, socioeconomic status, and previously earned grades in mathematics. Data came from the base year of the National Educational Longitudinal Study of Eight Graders (NELS 88). A random sample of 180 students consisting of 30 Black males, 30 Black females, 30 White males, 30 White females, 30 Hispanic males, and 30 Hispanic females were selected from the data set. Multiple regression analysis was used to analyze the data. Females were no less likely to score well on mathematics standardized test scores than were their male counterparts. However, there were differences between racial groups. The effects of socioeconomic status varied among groups but were found to be consistently significant across racial lines.

Introduction

The results of previous research identified gender, race, socioeconomic status (SES), and mathematics course grades and their impact on predicting success on standardized test scores. Do boys always score better than girls do? Do Asians and Whites always score higher than Hispanics and Blacks? Do students from higher socioeconomic backgrounds usually score above those from lower SES backgrounds? Can grades in mathematics practically and statistically predict student performance on standardized tests? Researchers have identified a positive correlation in various domains that may or may not impact student performance on mathematics standardized tests.

This study undertook an analysis of the National Educational Longitudinal Study of Eighth Graders (NELS 88) for the purposes of determining a relationship among gender, race, socioeconomic status, and mathematics course grades in predicting mathematics standardized test scores. The specific hypotheses tested in this study were: (a) there is no statistically significant relationship between standardized mathematics scores and the composite of socioeconomic status and mathematics grades from sixth grade until eight grades; (b) there is no statistically significant relationship between mathematics standardized test scores and race when controlling for socioeconomic status and mathematics grades; (c) there is no statistically significant relationship between standardized math test scores and gender when controlling for the composite of socioeconomic status, math grades, and race; (d) there is no statistically significant relationship between math standardized test scores and the interaction between gender and race; (e) there is no statistically significant relationship between math standardized test scores and the interaction of grades and gender; (f) there is no statistically significant relationship between math standardized test scores and the interaction between grades and race; (g) there is no statistically significant relationship between standardized mathematics test scores and the interaction of math grades and socioeconomic status; (h) there is no statistically significant relationship between math standardized test scores and the interaction of gender and socioeconomic status; and (i) there is no statistically significant relationship between mathematics standardized test scores and the interaction of race and socioeconomic status.

Review of the Literature

In reviewing the literature of three investigators who studied subsamples of NELS 88, various predictors were set forth as variables that influenced student performance on mathematics standardized tests. Through multiple regression, Meyinsse and Tashakkori, (1994) analyzed the data and found that the socioeconomic status indicator was the best predictor of math performance. There was an inverse relationship between scores related to race and a number of other factors including the percentage of minority students enrolled in a particular school. Performance levels varied among ethnic groups. African Americans performed poorly and below Caucasians. In another study of NELS 88, Keith and Lichtman (1992) investigated the influence of Hispanic-Mexican parent involvement and parent's influence on test scores. However, the strongest influence on academic achievement was found to be previous grades. Findings from another study of NELS 88, Hoofer (1995) found that students who completed more math courses showed greater achievement scores regardless of gender or race-ethnicity, and socioeconomic status. Asians completed more courses in math than Whites, and Whites completed more courses than Blacks and Hispanics.

At schools with students of different racial groups, Asians and Whites tested at higher levels than Blacks and Hispanics. However, when SES and school type were controlled, little differences were found in achievement levels between students of different races. The differences were seen mostly in the great number of Whites and Asians who were in the highest quartile in contrast to the great number of Blacks and Hispanics who were in the lowest quartile using national norms (Lewis, 1990).

Various researchers have studied regressing standardized scores on gender. Testing differences between genders became more exaggerated with age. That is, as students grew older their grades in schools remained relatively unchanged between males and females but standardized test score differences rose. The difference was found in males having higher scores than females (Hyde, Fennema, & Lamon, 1990).

According to Gallagher and De Lisi (1994) one deviation was that females tended to score better when the problem set required conventional solutions as opposed to unconventional problem solving. Thus, females tended to be more successful in process oriented mathematics and perhaps more successful in classroom oriented activities and less successful in the realm of unconventional problem solving strategies as posed by standardized tests. Boys often entered mathematics classes with significantly greater knowledge of terminology and definitions (Dees, 1982). The author postulated four reasons why boys displayed the greater familiarity (a) boys took industrial arts courses in greater numbers than girls giving them greater access to practical applications to mathematics; (b) boys may be more readily provided assistance in areas such as carpentry and surveying; (c) boys played recreational and leisure activities that exposed them to mathematics; and (d) finally, boys tended to be more involved in mathematics activities

activities outside the classroom. One possible solution for diminishing gender differences in performance on standardized tests was to control for environmental factors impacting students at very young ages (Gallagher, 1998).

Brown and Josephs (1999) found that beliefs in mathematics abilities were directly correlated to mathematics achievement on standardized tests. In fact, females performed poorly if they believed that they were taking a test designed to indicate whether they were especially weak in math. Further, the researchers extrapolated that as individuals deepen self-doubt beliefs they placed roadblocks that minimized performance. Conversely, these researchers believed that classroom teachers often modify the classroom environment to meet the needs of females, but when it came to standardized tests, the females' belief system took over and led to poor performance.

Parental influences and the school climate also contributed to a particular student's performance on standardized tests. Students performed up to a standard set by their immediate realm of influence. That realm was composed of it gender peers, trusted adults, and the opposite gender. Female students were less inclined or less motivated by any combination of factors stated previously. Teachers were not totally empowered to counteract any of the other influences because at various age groups, different realms exerted varying degrees of power. For example, in elementary school, parents consoled a young girl when not performing well in mathematics. Young females were told that it was okay because either girls were not good at mathematics or that the parents themselves were not good at mathematics. In the middle grades, the same sex peer group indicated that it was not cool to be good at mathematics. In high school, females were overly sensitive to the opposite sex peer group, not wanting to be smarter than boys (Adams, 1998).

Contrary to the beliefs of some educators, correlations of test scores and grades were found to be low. It was generally believed that as test scores increased, grades earned would increase and vice versa; however, this was not the case in the data under consideration in a study by Wattenbarger and McLeod (1989) where the correlations of test scores and grades were found to be low. Almost half of the correlations were negative.

Grades were difficult to correlate due to the subjectivity of their nature. Assumptions were made by Hill (1989) that there were differences in teachers' grading systems. Correlations of previous grades with current grades were only .48 and .52. Grading procedures used by some teachers varied in weighting. Greater emphasis was put on different areas such as homework, classwork, tests and quizzes by a sample of teachers.

Some of these contradictions were also noted between a girl's higher report card grades and lower standardized test scores. (Sadker & Sadker, 1988). Confirming this study, Brown University found that although boys scored 53 points higher on the SAT than girls did, girls did better than boys on their high school report card (Brown University, 1994). Kimball (1989) found that female students often garner higher grades in mathematics classes; however, the female's scores on standardized tests as compared to males was often lower. Odell and Schumacher (1998) offered an explanation that females preferred familiarity and "textbook-like questions" to the "novel and nonroutine" questions of the SAT. Even though females did not feel that SAT scores "underrepresented their ability"(p.34). Findings from Gallagher and Lisi (1994) indicated that even though female students often outscored male students in conventional problem solving and tended to have comparable grades in mathematics, they usually scored lower in unconventional problem solving. Hence, female students scored lower on standardized test scores as compared to male students.

Looking at the Stanford Achievement Test as a predictor of mathematics grades, Santa Rosa Junior College looked at math test scores and found that they did not significantly correlate with mathematics course grades (Santa Rosa Junior College, 1984). Another study investigated whether the constant decline in Scholastic Aptitude Test (SAT) mathematics scores reflected a decrease in student mathematical ability or the SAT's inadequacy in measuring mathematical ability. The results yielded a low to moderate correlation's with each student's math grade of six graduating classes at one university (Grougeon, 1985).

There has been a plethora of educational research on the effects of standardized test scores regressed on socioeconomic status. Ever since Coleman (1966) asserted that socioeconomic status played a greater role in the success of a child than did the school, researchers ~~have~~ delved into the effects of socioeconomic status on students' achievement. In the 1970s, researchers like Edmonds (1978) disagreed with Coleman and stated that effective schools could counter low socioeconomic effects experienced by students. Edmonds (1979) was able to bolster his effective schools research by identifying effective schools in which low socioeconomic students experienced success.

The Texas Education Agency (1979) administered the reading and mathematics tests of the ~~Iowa~~ Test of Basic ~~Skills (ITBS) and~~ found that the scores of students from

Although June (1986) found that high socioeconomic students' scores on the California Achievement Subtest of Mathematics fell significantly below expectations.

Houser (1996) stated that "nonbaccalaureate students of low socioeconomic status were more likely to be vocational majors than were students with high socioeconomic status" (p. 2). Moreover, Verna (1997) conducted a study involving male and female high achieving high school students (ages 16-18) on causal linkages among home environment, self-concepts, prior ability, and socioeconomic status on mathematics achievement, science achievement and Scholastic Aptitude Test-Quantitative (SAT-Q) and Verbal scores. The researchers found that socioeconomic status was a major contributing force for family processes and offered a positive connection with prior ability. The researchers demonstrated that the composite variable of socioeconomic status influenced achievement through intervening variables such as family process, academic self-concepts and prior achievement. Verna (1997) stated that "socioeconomic status played an important role in students' academic growth. Therefore, this study included socioeconomic status of the family, which was determined by father's and mother's education and occupation" (p. 4).

Basten (1997) conducted a study of freshman entering college. The researcher compared income levels (high, medium and low) with SAT total scores (high, medium, and low). The percentages of respondents were as follows:

> Low Income, Low SAT, 35.3%; Low Income, Medium SAT, 31.9%; and Low Income/High SAT, 27%; Medium Income, Low SAT, 53.1%; Medium Income, Medium SAT, 54.1%; Medium Income, High SAT, 56.3%; High Income, Low

SAT, 12.9%; High Income, Medium SAT, 14%; and High Income/High SAT, 16.8%.

In summary, what remained unexamined to a large extent in the review of the literature was how grades were predictors for standardized test scores. As was seen grades are subjective to teacher judgement and difficult to measure reliably. Gender studies indicated that generally males outscored females on standardized tests, but not in academic grades. When not controlling for SES and holding all other variables constant, race was shown to be a predictor based on the amount of mathematics courses taken and the percentage of minority students enrolled in a particular school favoring Asians and Whites. Socioeconomic status vacillated throughout the literature as far as being a significant predictor of standardized test scores.

Methodology

This section explains the procedures used in carrying out this study. It focuses on the specific information necessary to insure replicability.

Subjects

Data came from the base year of the National Educational Longitudinal Study of Eight Graders (NELS 88) which consisted of 1,500 students. A random sample of 180 students consisting of 30 Black males, 30 Black females, 30 White males, 30 White females, 30 Hispanic males, and 30 Hispanic females were selected from the data set.

Model

The following variables were used to predict mathematics standardized test scores: race, gender, socioeconomic status (SES), and mathematics grades from grade six until now. Multiple regression was used to analyze the data. The following models were used:

Model 1: Mathematics grades from sixth grade to now and socioeconomic status

Model 2: Mathematics grades from sixth grade to now, socioeconomic status, and race

Model 3: Mathematics grades from sixth grade to now, socioeconomic status, race, and gender

Model 4: Mathematics grades from sixth grade to now, socioeconomic status, race, gender, and the interaction between race and gender

Model 5: Mathematics grades from sixth grade to now, socioeconomic status, race, gender, and the interaction between grades and gender

Model 6: Mathematics grades from sixth grade to now, socioeconomic status, race, gender, and the interaction between grades and race

Model 7: Mathematics grades from sixth grade to now, socioeconomic status, race, gender, and the interaction between grades and socioeconomic status

Model 8: Mathematics grades from sixth grade to now, socioeconomic status, race, gender, and the interaction between gender and socioeconomic status

Model 9: Mathematics grades from sixth grade to now, socioeconomic status, race, gender, and the interaction between race and socioeconomic status

Analysis

The study was conducted utilizing SPSS 9.0 with linear regression analysis. Mathematics standardized test scores were regressed on mathematics grades, socioeconomic status, race, gender, and appropriate interactions. Effect coding was used for race and gender.

Variables and Measurement

The continuous dependent variable was mathematics standardized test scores. The independent, continuous, predictor variables of math grades and socioeconomic status used the central tendency measure of the mean. A histogram or a standard deviation represented the measure of variability. The other independent, categorical, predictor variables of race and gender used percentages and a bar graph in representing the data. The measure of central tendency for this categorical data was mode. The actual range for SES was –2.97 through 2-56.

Procedure

The data was analyzed using linear regression. Mathematics standardized test scores were regressed on grades, SES, gender and race. Model two was chosen. Cross-validation procedure found no significance on model two.

Results

Cross validation found no significance, the specific hypotheses were tested, and the results are displayed in the following eight tables:

Hypothesis one

There is no statistically significant relationship between standardized mathematics scores and the composite of socioeconomic status and mathematics grades from sixth grade until eight grade.

Table 1

Analysis of Variance for Mathematics Standardized Test Scores

Source	SS	df	MS	F	p	R^2
Regression	3252.76	2	1626.378	25.375	.000	.232
Residual	10767.58	168	64.093			
Total	14020.33	170				

Hypothesis one was rejected. The variance explained was 23.2%.

Hypothesis two

There is no statistically significant relationship between mathematics standardized test scores and race when controlling for socioeconomic status and mathematics grades

Table 2

Analysis of Variance for Mathematics Standardized Test Scores

Source	SS	df	MS	F	p	R^2
Regression	3683.6	4	920.898	14.789	.000	.263
Residual	10336.74	166	62.269			
Total	14020.33	170				

Hypothesis two was rejected. The variance explained was 26.3%.

Hypothesis three

There is no statistically significant relationship between standardized math test scores and gender when controlling for the composite of socioeconomic status, math grades, and race.

Table 3

Analysis of Variance for Mathematics Standardized Test Scores

Source	SS	df	MS	F	p	R^2
Regression	3708.13	5	741.623	11.867	.000	.264
Residual	10312.2	165	62.5			
Total	14020.33	170				

Hypothesis three was rejected. The variance explained was 26.4%.

Hypothesis four

There is no statistically significant relationship between math standardized test scores and the interaction between gender and race.

Table 4

Analysis of Variance for Mathematics Standardized Test Scores

Source	SS	df	MS	F	p	R^2
Regression	3850.3	7	550.042	8.816	.000	.275
Residual	10170.03	163	62.393			
Total	14020.33	170				

Hypothesis four is rejected. The variance explained was 27.5%.

Hypothesis five

There is no statistically significant relationship between math standardized test scores and the interaction of grades and gender.

Table 5

Analysis of Variance for Mathematics Standardized Test Scores

Source	SS	df	MS	F	p	R^2
Regression	3865.24	8	483.16	7.708	.000	.276
Residual	10155.09	162	62.686			
Total	14020.33	170				

Hypothesis five is rejected. The variance explained was 27.6%.

Hypothesis six

There is no statistically significant relationship between math standardized test scores and the interaction of grades and race.

Table 6

Analysis of Variance for Mathematics Standardized Test Scores

Source	SS	df	MS	F	p	R^2
Regression	3940.63	10	394.063	6.255	.000	.281
Residual	10079.7	160	62.998			
Total	14020.33	170				

Hypothesis six is rejected. The variance explained was 26.1%.

Hypothesis seven

There is no statistically significant relationship between standardized mathematics test scores and the interaction of math grades and socioeconomic.

Table 7

Analysis of Variance for Mathematics Standardized Test Scores

Source	SS	df	MS	F	p	R^2
Regression	3948.212	11	358.928	5.666	.000	.282
Residual	10072.12	159	63.347			
Total	14020.33	170				

Hypothesis seven is rejected. The variance explained was 28.2%.

Hypothesis eight

There is no statistically significant relationship between mathematics standardized test scores and the interaction of race and socioeconomic status.

Table 8

Analysis of Variance for Mathematics Standardized Test Scores

Source	SS	df	MS	F	p	R^2
Regression	4031.648	13	310.127	4.875	.000	.288
Residual	9988.681	157	63.622			
Total	14020.33	170				

Hypothesis 8 is rejected. The variance explained was 28.8%.

Discussion and Conclusions

There are several implications apparent within the scope of this study. Significant relationships for all hypotheses are stated in this study. However, the resulting equations lacked practicality and applicability be cause of low significance in the various models contained in the coefficients table. Furthermore, at best only 28.8% of the total variance can be explained. None of the R squared changes were noted to significantly increase the power of the equation after the second model. Model two accounted for 26.3% of the variance explained and included the composite of math grades from grade six until now, socioeconomic status, and race at a significance level of p= .034. The significance of the equation is correlated to the mathematics standardized test scores at the following: $\underline{F}$ (4, 166)=14.789, p=.000.

Cross-validation was accomplished by splitting the data in half (n=84), the predicted mathematics standardized test scores were obtained by using the best-fit model equation (Model two), as follows: 55.23 + 3(SES) – 3.3(math grades) – 2.5(effracewhite) + .54(effraceblack). Then, the error vector was obtained by subtracting the actual mathematics standardized scores from the predicted mathematics scores. Next, all cases were selected and an independent *t* test was run to determine if there was a difference in residual between selected and unselected cases. There was no statistical significance; therefore, the equation was appropriate for the entire population.

All interactions yielded significance greater than p = 0.05. Therefore, no interaction models were selected for use in this study.

SPSS found perfect collinearity between SES and gender, and therefore this model was dropped out automatically. Collinearity was of no consequence in any of the other models. Collinearity diagnostics were all within the range of 1 to 11.738. Betas were within acceptable ranges.

Three specific cases were highlighted in the casewise diagnostics table. Case 50, 74 and 165 were investigated for nearing the third standard deviation of error. Upon further scrutiny, the cases were unadjusted and believed of value to this study.

The charts showed a positively skewed histogram of the mathematics standardized score residuals. Moreover, the Press scatterplot (jack-knife) may indicate a pattern of a positive linear relationship. This may be indicative of other events. The Partial Regression Plots for SES yielded .0219, .0236, and .0269 for linear, quadratic, and cubic respectively. The Partial Regression Plots for Grades for mathematics Grade 6 until now yielded .1175, .1188, and .1262 for linear, quadratic, and cubic respectively. The Partial Regression Plots for Race White yielded .0153, 0162, .0213 for linear, quadratic, and cubic respectively. The Partial Regression Plots for Race Black yielded .0011, .0117, .0127 for linear, quadratic, and cubic respectively. Obviously, there was no significance in any of the partial regression plots.

The literature supports the results of this study. The main effects on standardized test scores by socioeconomic status was supported by the research by Meyinsse and Tashakkori (1994) these authors found socioeconomic status to be the best predictor of performance on mathematics standardized tests. Accordingly, Lewis (1990) found that race in and of it self was not an indicator of mathematics performance but a categorical equivalent that most accurately separated students by socioeconomic status. When controlling for SES, Lewis (1990) found no statistically significant differences in race and performance on mathematics standardized test scores.

This study found 28.8% variance explained while a review of the literature failed to state any R Squared value greater than the 28.8%. Therefore, based on a review of the literature, even this low R Squared value is practically significant.

In the future, these researchers suggest that more current data and a new reliable and valid instrument be created for measuring these variables. More focus needs to be placed on defining SES and refraining from using composite grades. Consideration should be made for including Asians in the race group. This can only be obtained by gathering enough new data to equally represent that population.

This study can help educators understand the relationships between SES, gender, and race affecting student performance in mathematics standardized tests. This opens new inroads into teacher training. A by-product of the teacher training would lead teachers to a greater understanding that lower SES students possess equal potential and can achieve along the lines of the higher SES students, even though they may have scored lower on some standardized tests.

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